

Section 9-3: rotations

Learning objective: be able to

- identify rotations
- write rotational transformation equations
- graph the image of rotations

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Section 9-3: rotations

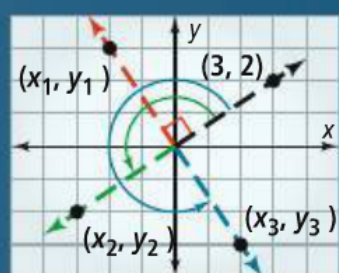
Questions you should be able to answer by the end of the section:

- what are the properties of rotations (orientation, size and shape)?
- how do they compare to other transformations (how are they alike and dislike)?
- what is the difference between rotating in place and rotating around a point?

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What is a rotation?

In the diagram, the point $(3, 2)$ is rotated counterclockwise about the origin. The point (x_1, y_1) is the result of a 90° rotation. The point (x_2, y_2) is the result of a 180° rotation, and the point (x_3, y_3) is the result of a 270° rotation. What are the coordinates of (x_1, y_1) , (x_2, y_2) , and (x_3, y_3) ? What do you notice about how the coordinates of the points relate to the coordinates $(3, 2)$ after each rotation?



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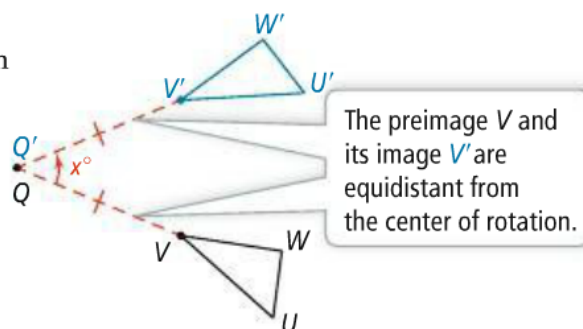
What is a rotation?

A **rotation** of x° about a point Q , called the **center of rotation**, is a transformation with these two properties:

- The image of Q is itself (that is, $Q' = Q$).
- For any other point V , $QV' = QV$ and $m\angle VQV' = x$.

The number of degrees a figure rotates is the **angle of rotation**.

A rotation about a point is a rigid motion. You write the x° rotation of $\triangle UVW$ about point Q as $r_{(x^\circ, Q)}(\triangle UVW) = \triangle U'V'W'$.



Rotations are assumed to be **counter-clockwise** if not specified otherwise.

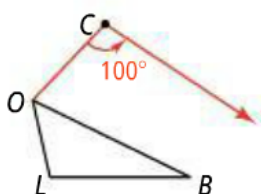
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Problem 1 Drawing a Rotation Image

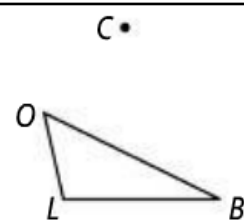
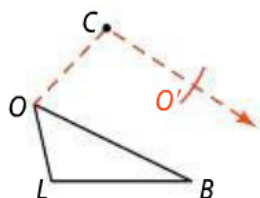
What is the image of $r_{(100^\circ, C)}(\triangle LOB)$?

Step 1

Draw \overline{CO} . Use a protractor to draw a 100° angle with vertex C and side \overline{CO} .

**Step 2**

Use a compass to construct $\overline{CO'} \cong \overline{CO}$.



Preimage

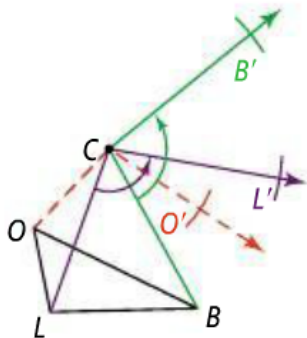
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Problem 1 Drawing a Rotation Image

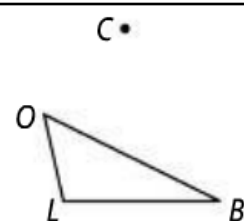
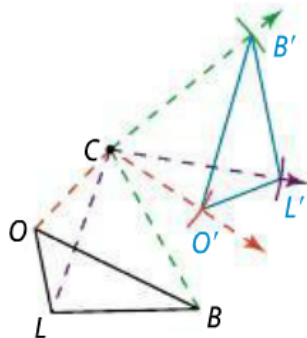
What is the image of $r_{(100^\circ, C)}(\triangle LOB)$?

Step 3

Locate B' and L' in a similar manner.

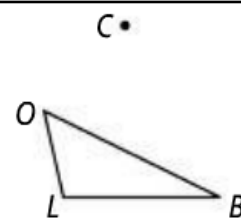
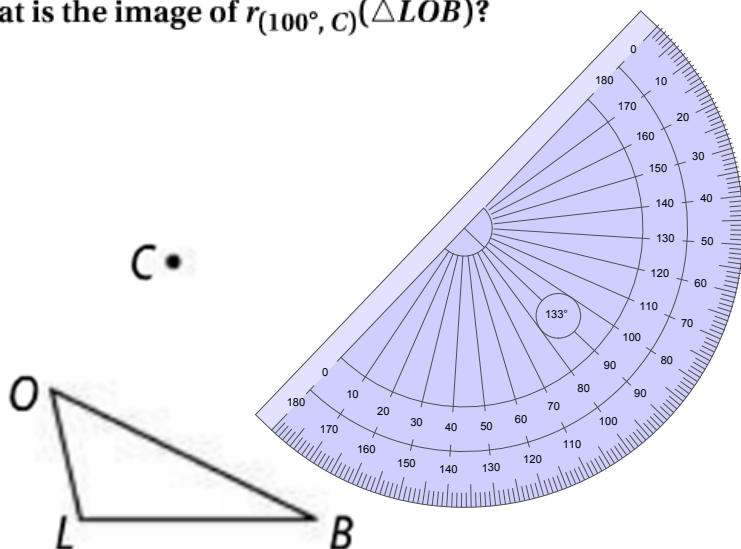
**Step 4**

Draw $\triangle L'O'B'$.



Preimage

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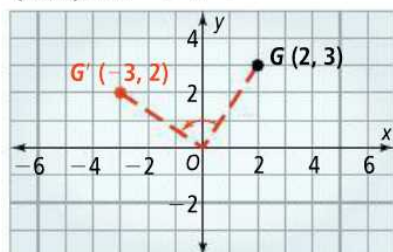
Problem 1 Drawing a Rotation ImageWhat is the image of $r_{(100^\circ, C)}(\triangle LOB)$?

Preimage

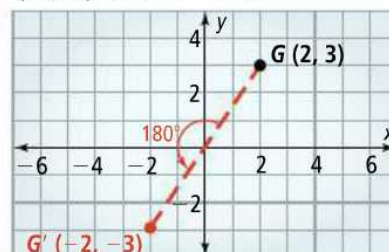
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The
short-cut!

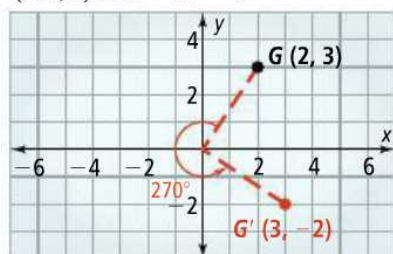
$$r_{(90^\circ, O)}(x, y) = (-y, x)$$



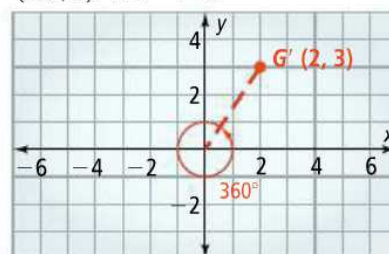
$$r_{(180^\circ, O)}(x, y) = (-x, -y)$$



$$r_{(270^\circ, O)}(x, y) = (y, -x)$$



$$r_{(360^\circ, O)}(x, y) = (x, y)$$



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Example!

$PQRS$ has vertices $P(1, 1)$, $Q(3, 3)$, $R(4, 1)$, and $S(3, 0)$.

What is the graph of $r_{(90^\circ, O)}(PQRS)$.

First, graph the images of each vertex.

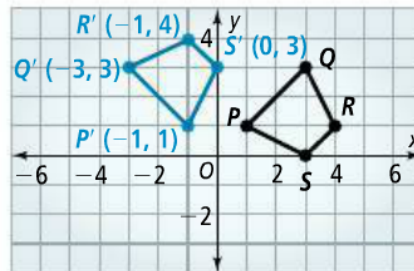
$$P' = r_{(90^\circ, O)}(1, 1) = (-1, 1)$$

$$Q' = r_{(90^\circ, O)}(3, 3) = (-3, 3)$$

$$R' = r_{(90^\circ, O)}(4, 1) = (-1, 4)$$

$$S' = r_{(90^\circ, O)}(3, 0) = (0, 3)$$

Next, connect the vertices to graph $P'Q'R'S'$.



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Exploration!

Example: rotating a letter

http://www.maa.org/sites/default/files/images/upload_library/47/Crowe/GeoGebra_Activity_2.html

Transmographer

<http://www.shodor.org/interactivate/activities/Transmographer/>

Explore these websites and answer the questions from the beginning of the lesson.

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Exit Slip!

What are the new coordinates of triangle ABC; A(2,0), B(3,5), C(4,2) after it has been rotated:

90°

180°

270°

360°

Rate yourself from 1
(lowest) to 4 (highest)
on your level of
understanding.

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